HALO OBSERVATIONS AT YORK, N. Y.

By MILROY N. STEWART, Cooperative Observer.

[Dated York, Livingston County, N. Y., Sept. 18, 1915.]

The halos recorded in the following tables were observed at York, N. Y. (N. 42° 52′ 30″; W. 77° 53′). The usual records of a cooperative observer have been kept since December, 1911, while less complete notes date from three years earlier. The nearest Weather Bureau station is at Rochester, 26 miles to the north-northeast.

TABLE 1.—*The numbers of halos observed at York, N. Y., January, 1909, to September, 1915, inclusive.*

Year.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Total.
						A. SOLAR HALOS.							
1909	1	2	2	6	4	4	3	1	1	3	0	0	27
1910	2	4	2	0	4	3	0	0	3	2	2	3	25
1911	1	3	6	5	5	3	3	4	2	5	0	2	39
1912	7	2	12	6	5	4	4	2	6	6	3	3	60
1913	9	6	6	4	6	3	6	6	6	8	4	2	66
1914	4	10	8	3	3	5	5	5	6	2	6	4	61
1915	7	2	2	8	2	7	9	7	8	.....	.....	.....	[47]
Totals	31	29	38	27	29	29	30	25	32	26	15	14	325
Means	4.4	4.1	5.4	3.8	4.1	4.1	4.3	3.6	4.6	4.3	2.5	2.3	.....
Smoothed means[1]	4.1	4.5	4.7	4.2	4.[illegible]	4.1	4.1	3.9	4.3	3.8	2.9	2.9	.....
						B. LUNAR HALOS.							
1909	1	0	0	3	0	1	0	0	1	0	3	1	10
1910	1	2	0	0	1	0	0	0	0	1	0	3	8
1911	3	2	3	0	0	0	0	0	0	1	1	1	11
1912	0	1	1	0	0	0	0	0	0	2	3	2	9
1913	2	0	0	0	3	0	1	0	0	0	1	1	8
1914	1	0	3	0	1	0	0	1	0	0	1	2	9
1915	1	0	2	1	1	0	0	1	3	.....	.....	.....	[9]
Totals	9	5	9	4	6	1	1	2	4	4	9	10	64
Means	1.3	0.7	1.3	0.6	0.9	0.1	0.1	0.3	0.6	0.6	1.3	1.6	.....
Smoothed means[1]	1.2	1.0	1.0	0.8	0 6	0.3	0.15	0.2	0.5	0.65	1.2	1.4	.....

[1] E. g., January $= \frac{\text{Dec.} + 2\ \text{Jan.} + \text{Feb.}}{4}$

Table 1 includes all halos noted and shows their relative monthly frequency. It is quite evident that many displays must have been missed during 1909, 1910, and 1911. Owing to the deficiency of the records for those years the computations of the time elapsing between halos and succeeding precipitation are based chiefly upon the observations of the last three and a half years.

It is a source of regret to the writer that unfamiliarity with practical methods has prevented angular measurements of the individual phenomena.

Table 2 is designed to bring out the frequency with which the halos were followed by precipitation, and the length of time before such precipitation usually occurred. The results seem less uniform—with regard to seasonal effects—than those obtained at Blue Hill. A similar March maximum is found, but the minimum occurs in December rather than in October. The normal length of time elapsing before precipitation (20.5 hours) is quite a bit in excess of that at Blue Hill (15.6 hours). Lunar halos have been omitted from Table 2, but a study of 55 shows that 46 (83 per cent) were followed by rain or snow before the end of the second succeeding day. In the case of these halos the precipitation appears to follow more quickly—the average interval being 17.3 hours.

It is noted that halos which are not followed by precipitation often occur in succession. Those on September 10, 11, 14, 18 and 20, 1914, are examples. Indeed at this station 37 per cent of all observed September halos have been succeeded by more than two days of fair weather.

TABLE 2.—*Relations of occurrence of solar halos to occurrence of precipitation at York, N. Y., from December, 1908, to September, 1915.*

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November	December.	Totals and means.
SOLAR HALOS.													
Total number considered	31	29	38	27	29	29	30	25	24	26	15	14	317
Percentage followed by precipitation on same day	13	31	39	22	10	24	23	20	19	27	33	21	23.5
Percentage followed by precipitation on first succeeding day	61	62	74	66	76	41	73	88	53	38	73	64	64.0
Percentage followed by precipitation on second succeeding day	58	65	54	44	51	48	70	56	40	31	66	64	53.9
Average number of hours between halo and precipitation	21.4	*13.7*	20.2	19.3	20.7	21.2	26.5	19.5	19.6	22.6	18.6	22.0	20.4
Percentage not followed by precipitation by end of second succeeding day	19	14	11	15	7	27	7	12	37	27	13	14	17
Average hour of occurrence (first seen)	12.1	12.4	12.5	11.7	11.9	12.2	8.7	12.9	11.7	11.7	12.4	11.8	11.7

The wind direction, at the times halos have been noted, has been prevailingly south with the exception of the month of December when it has been southwest.

Unusual displays at York, N. Y.—By far the greater number of recorded displays consisted merely of the 22°-halo—often with accompanying parhelia, especially in the late afternoon. A few times more complex phenomena were seen. On March 14, 1912, concentric halos of 22° and 46° became visible at about 7:30 a. m. Both showed red on the side toward the sun. The colors of the outer circle were the more distinct.

The inner halo was much brighter through an arc of about 35° on its upper (west) side and parhelia were visible. The north side of the whole display was the brightest because the clouds were thickening on the south. At the uppermost point of the 46°-halo there was, tangent to it, what appeared to be an arc of a circle of about 22°. This was brilliantly colored with the red on its convex side. Green was the color most in evidence. This tangent arc increased in brilliancy until 8:20 a. m., when it began to fade and was followed 10 minutes later by the 46°-halo. The 22°-halo lasted to about 10 a. m. There was (8 a. m.) a white spot in the north at an altitude above the horizon equal to that of the sun, and of the size of a parhelion. The temperature was about 20°F., wind south. Snow, changing to rain, began during the following night, and 0.55 inch had fallen by 2 p. m. on the 15th.

April 4, 1912, at 4:30 p. m., the circumzenithal arc was seen. Red, blue, and green could be distinguished. Temperature, 38°F.; wind, SW. The barometer fell 0.45 inch during the next 24 hours, but no precipitation more than a trace occurred till the 7th.

On February 9, 1914, at 9 a. m., there was a faint 22°-halo with parhelia. The circumzenithal arc was visible, showing red and blue-green. Temperature, 10°F.; wind, W. A light snowfall followed in 26 hours. On February 13, there was a display similar to that on the 9th, but occurring at 2:45 p. m. The 22°-halo had been visible in the forenoon, with its highest and lowest parts especially bright. Temperature, 15°F.; wind, NE. A snowfall amounting to 10.5 inches began at 6 p. m.—only three hours later.

On January 16, 1915, at noon, a 22°-halo was observed. At 12:20 p. m., an arc appeared about 46° above the sun, having the colors of the circumzenithal arc, but apparently concave toward the sun. At the same time the upper portion of the 22°-halo became brighter, and assumed the form indicated in figure 2. The east parhelion made its appearance at about 1:20 p. m. There was an intensely bright, white area just at and above the juncture of the 22°-halo and its tangent arcs. The colored arc faded at 1:45 p. m.; the upper part of the 22°-halo was still visible at 3:30, but disappeared soon after. Temperature, 35°F.; wind, S. Rain began after an interval of 17 hours and fell on the nine succeeding days.

CUMULUS OVER A FIRE.

By EDW. N. MUNNS.

[Dated Converse Experiment Station, Redlands, Cal., Aug. 5, 1915.]

During a brush fire on August 5, 1915, a cumulus cloud developed at the head of the smoke. The cloud appeared first at 3:05 p. m., lasting 20 minutes. It reappeared at 4:55 p. m., and lasted 12 minutes. The cloud was a typical cumulus, and formed close to 1,000 feet above the fire area.

ELECTRICITY OF ATMOSPHERIC PRECIPITATION.[1]

By G. C. SIMPSON.

[*Reprinted from* Science Abstracts, Sec. A, Sept. 25, 1915, § 1305.]

While there are still certain questions relating to the electrical state of precipitation which have not been answered definitely, the broad features are now generally agreed upon by all observers. To account for these features two theories have been put forward: (*a*) The influence theory of Elster and Geitel; and (*b*) Simpson's "breaking drop" theory. In the present paper these two theories are considered, particularly with reference to the manner in which they will explain the observed facts. Elster and Geitel's influence theory (*a*) is based upon the idea that small water drops can come into electrical contact with large ones without uniting with them. Simpson considers that this supposition is far from established, and further suggests that even if sound it will not satisfactorily account for the electrical phenomena observed during rain. When the breaking-drop theory (*b*) was first put forward, evidence was adduced to show that it fully accounted for the electrical phenomena found with thunderstorms, but nonthunderstorm rain and snow were not so fully dealt with. There has been some doubt as to whether breaking of drops does actually occur with ordinary steady rain, and without such breaking the theory fails. Evidence is brought forward to show that such breaking of large drops into small ones does occur in a gusty wind and will probably occur also to some extent in a still atmosphere, and this being granted, it is found that the theory will satisfactorily account for the changes of potential gradient which occur near the ground during rain in addition to explaining the charge on the rain itself. With regard to snow, it is suggested that the rubbing together of the flakes will produce electrification in the same way that Rudge has found electrification to be produced in dust clouds, and this action will correspond with the breaking of drops in the case of rain.[2]—*J. S. Dines.*

AURORA OBSERVATIONS IN 1913.[3]

By C. STÖRMER.

[*Reprinted from* Science Abstracts, Sec. A, Sept. 25, 1915, § 1236.]

Although only a part of the material obtained on the expedition to Bossekop in 1913 has been worked up, the author has now details of about 600 very exact measurements of the altitude of the aurora and of its positions in space, all determined from photographs taken simultaneously from the two stations, Bossekop and Store Korsnes, lying about 27.5 kilometers from each other in a north and south line, and connected by telephone for direction of the observations. A notable result is the consistency with which the lower limit of altitude for the auroras is found to be from 90 to 100 kilometers.

The pictures of the auroral draperies on March 11–12, 1913, have been examined for the purpose of determining the nature of the discharge. For this magnetograms for the same epoch were obtained from the observatory at Haldde, about 13 kilometers west of Bossekop. Marked perturbations were visible on the magnetograms, showing that the magnetic action was so directed that it had components pointing to the north, west, and upward. Assuming that the electric corpuscles descend into the atmosphere from without, along the magnetic lines of force, forming auroral rays which combine to form the drapery, we can find by a simple application of Ampère's law that it seems to be proved that the aurora was caused by positively-charged electric particles. Diagrams are given in illustration of this view.—*C. P. Butler.*

THE GREAT AURORA OF JUNE 16, 1915.[4]

By E. E. BARNARD.

[*Reprinted from* Science Abstracts, Sec. A, Sept. 25, 1915, § 1235.]

A very remarkable exhibition of auroral activity was observed at the Yerkes Observatory on the night of June 16, 1915. Starting in the form of a strong low-lying arch without streamers, the activity gradually increased until the brilliant glow reached the pole, the lower portions being broken with bright moving masses and the upper part being double. After dying down, the phenomenon was repeated some hours later, and then the arch structure gave place to long ascending streamers, quick waves of auroral light rising to the zenith with remarkable rapidity. These continued for over an hour until further observation was interrupted by dawn. The maximum intensity occurred about 8:15 a. m., G. M. T., on June 17. A few of the brightest masses could be detected 20 minutes after dawn. There was little color in the display at any time, although a few of the streamers gave indications of a pink tinge. Photographs of the sky taken during the display were found to be badly fogged by the auroral light, which seemed to be more actinic than moonlight.

Widespread effects on telegraph systems appear to have occurred at the same time as the aurora. On the other hand wireless signals appear to have been normal throughout the period of the maximum display.—*C. P. Butler.*

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[1] *See* Phil. Mag., London, July, 1915, 29: 1-12.

[2] A summary of Simpson's previous conclusions will be found in this REVIEW, June, 1914, 42: 348.—C. A., jr.

[3] Terrestrial Magnetism, March, 1915, 20: 1-12.

[4] See Nature (London), July 15, 1915, 95: 536-537.